Optimization and Computational Biology (Spring 2008)
Homework 1

• Be concise when answering questions on biology, but do include all necessary details.
• This homework is due in class on Tuesday, Jan 29.

1. (10) Compare the structure of DNA and RNA.
2. (10) Describe the three levels of protein structure.
3. (10) What are the main differences between prokaryotic and eukaryotic cells?
4. (15) There are $20^n$ different possible proteins of $n$ residues. If there were no orientation (i.e. if the N-terminus and C-terminus of the protein are indistinguishable), then the protein $R_1 R_2 \ldots R_n$ would be indistinguishable from $R_n \ldots R_2 R_1$. How many different proteins would be possible under this assumption?
5. (20) This exercise involves the use of the functions which are part of the Bioinformatics toolbox in MATLAB. You need to access the Help for this toolbox and find the appropriate functions needed for each task. Submit all commands and output in the homework.
   (a) Generate a random DNA, RNA, and a protein sequence, each of length 20.
   (b) Find the complementary strand to the DNA sequence.
   (c) Convert the DNA sequence to its corresponding RNA sequence (transcription).
   (d) Find the protein sequence corresponding to the RNA sequence found above (translation).
   (e) Now reverse the above RNA sequence, add a nucleotide to it (making its length 21), and find the protein sequence corresponding to the new RNA found.